

CHAPTER V

MAINTENANCE MANAGEMENT SYSTEMS

A. Purpose and Need

The primary function of a wastewater collection, treatment and disposal system is to provide a means for removal of contaminants from the liquid water produced by domestic persons, commercial, and industrial users such that the environment may still provide beneficial uses. Contaminates may include organic matter, chemicals, and bacterial matter. Beneficial uses of the environment include water resources, recreation and asthetic considerations.

To assure that the goals of wastewater treatment are attained and maintained, a system of permits and compliance, with permit requirements, has been established which is administered by the Regional Water Quality Control Board. The Regional Water Quality Control Board has established certain standards for plant operation, among the reliability goals.

In order for the goals of wastewater treatment to be attained, treatment facilities are often constructed that contain large quantities of mechanical equipment. Since mechanical equipment by its very nature of incorporating, moving and rubbing parts wear and eventually become non-usable, and therefore, threatens the orderly operation of the equipment, so a system of repairs and operational assurances is necessary. Such a system is referred to as a Maintenance Management System.

A properly designed Maintenance Management System must speak to equipment operational assurances, equipment repair, cost tracking, and efficient personnel usage. When all of these factors of the program are put together and implemented, breakdowns will be lessened, equipment life will be extended, and costs will be minimized.

The format of this chapter will be organized to present the necessary information for the Maintenance Management System; so it may be easily understood and then implemented. The chapter will be divided into sections to present each facet clearly. The sections are as follows:

- Equipment Record System
- Maintenance Planning and Scheduling
- Spare Parts Inventory
- Maintenance Personnel
- Cost Tracking

B. Equipment Record System

In developing an Equipment Record System, one of the first tasks is to devise a system to easily identify the equipment. If the system is to be placed on a computer data-file, then the name only would prove to be bulky. In the same respect, the name only, such as primary clarifier, does not readily identify which clarifier when more than one clarifier exists. In these respects, a numbering system must be devised that clearly identifies the piece of equipment. This is especially important if effective cost tracking is to be accomplished.

For the SAM facilities, a numbering system has been devised that not only satisfies the above needs, but also ties directly to the capital equipment inventory list. The system selected uses a eight digit base number. The number breaks down as follows:

XXYYZZZZ

Where XX represents the location of the equipment,  
YY represents the number of the equipment in that location.

ZZZZ represents the Year of Acquisition.

The areas of the plant and facilities are identified as follows:

- 01 Pretreatment (Headworks)
- 02 Primary Treatment
- 03 Secondary Treatment
- 04 Disinfection
- 05 Effluent Disposal
- 06 Aerobic Digester
- 07 Sludge Dewatering
- 08 Water Systems
- 09 Service Air System
- 10 Landscaping
- 11 Miscellaneous Equipment
- 12 Portola Pump Station
- 13 Princeton Pump Station
- 14 Montara Pump Station
- 15 Lab/Administration
- 16 Transmission Lines

The rest of the Equipment Record System involves establishment of a "card system", upon which the desirable information may be recorded for future use. Before this can be done, the goals for the Record System must be established. As previously stated, the goals of the Maintenance Management System is to provide for operational assurance, effective use of manpower, and cost tracking. An additional consideration should be manufacturer's information regarding suggested spare parts, supplier, and nameplate information. When this information is readily available, clear management decisions can be made regarding the question, "repair or replace?", and if replace, "replace with like kind or a different brand?"

With the above considerations, the following system has been developed for the Sewer Authority Mid-Coastside (SAM) facilities.

1. Equipment Information Card-

This card contains information regarding the date of purchase, time of purchase, the manufacturers' representative, name plate information, manufacturer, suggested spare parts.

2. Repair Record Card-

This card contains information regarding repairs made to the equipment including date of repair, what work was done, who did the work, hours required to do the work, and total cost of the repair.

3. Preventative Maintenance Task Card-

This card contains a listing of the preventative maintenance tasks to be performed.

Samples of the above three cards are provided as Figures VO-1, V-2, and V-3. Each of the cards, of course, includes the equipment identifier numbers and location in addition to the above stated information.

When all three of the cards are judiciously used by management, the following questions can then be answered.

1. Is the maintenance work on this item excessive?
2. Is the corrective maintenance repetitive?
3. When are breakdowns most likely to occur?
4. Is the preventative maintenance on a piece of equipment justified?

5. Can the maintenance be performed by outside contract?
6. Was the best use of manpower attained?
7. Is the data obtained sufficient?

In actuality, the Sewer Authority Mid-Coastside (SAM) facility does not use "cards" as such, as the above information has been put into a computer program readily and easily accessible for rapid data input and retrieval. The system has been designed to printout the card format when desired.

To make the system function, additional items must be implemented for the data to be available for input into the three card system. The forms required are the "work order form", and the "purchase requisition." These will be described under "Maintenance Planning and Building." In order for the system to produce the results desired, the data must be recorded. Paperwork generally is not the forte of the maintenance personnel. For this reason, the system must be made as simple as possible without sacrificing the desired result. It is anticipated that because of the limited staff and size of the plant, that the staff may at times feel overburdened with the paperwork. Personnel should be encouraged to complete the forms; so that the best utilization of manpower and available funds can be attained.

#### C. Maintenance Planning and Scheduling

All maintenance work must be scheduled in order to prevent wasted manpower and disruption of treatment processes. Such scheduling will vary with the necessity of work to be done, time of year, and available manpower. Maintenance generally falls into three categories; Preventative, Routine, and Breakdown.

## 1. Preventative Maintenance

Preventative Maintenance is usually defined as that maintenance which is done to prevent or reduce wear leading to early breakdown to the item. Tasks which usually fit into this category are lubrication, oil changes, drive belt adjustment, housekeeping, washdown, loose parts tightening, etc. In every sense of the work, auditory and visual inspection also come under the category of preventative maintenance.

Generally speaking, preventative maintenance is a function of the operations staff because of the familiarity with the equipment and necessity to shut the equipment down to perform the assigned tasks. The operator is in the best position to know when a piece of equipment may be taken out of service to accomplish the service. In the Sewer Authority Mid-Coastside (SAM) facility, the operators are assigned the responsibilities for performing the preventative maintenance.

On Monday of each week a printout is obtained from the computer listing the preventative maintenance task to be performed for the week. The list is given to the operations staff, and the list from the previous week is turned in for examination by the Superintendent for completeness. A space is provided on the list for the person doing the work to initial the work done.

In this manner the person controlling the work assignment can determine if the work was actually performed.

## 2. Routine Maintenance

Routine maintenance is usually defined as work that is performed on a regular basis to replace parts that have a known life expectancy. These parts may include gaskets and washers in the chemical feeders to the rotating parts in the pumps. Most manufacturers know from past experience what the life expectancy for various parts may be under certain service conditions. On critically operating equipment it is wise to schedule the replacement of these parts to prevent breakdown at critical operating times. The Work Order Form (Figure V-4), provides the tool for making their type of repair assignments. The Work Order Form will be devised later. Generally, these type of repairs would be accomplished by the maintenance staff.

Routine maintenance for some of the equipment is already scheduled in the preventative maintenance printout. When one of these type items appear in the schedule, a work order should be produced for issuance to the maintenance staff. The originator of the work order would be the person responsible for performing the preventative maintenance work assignments, in this case the Chief Plant Operator.

## 3. Breakdown Maintenance

Breakdown maintenance is usually defined as work required to re-establish normal operation of a piece of equipment that has unexpectedly failed. Such repairs are broad in range and cannot usually be planned.



Figure V-3A  
TYPICAL WEEKLY  
PREVENTATIVE MAINTENANCE  
WORK ORDER

000000: 2121

2013 2022

107010 220423

0103

1000000000000000000

0104

~~7-2307~~ 210401

000000 0105

00570 012501

01-0503  
67-28

12551 0106

[illegible]

204010

2010-01-07

0-76

REF: 010702

0108 217

09-01-2008 13:22

01:23 00:00:00

3020 0109

10622

226-0116

SECRET

11:04 4730

0225 011101

20110922

20117 430

7118 878

REF ID: A763

2025

[illegible]

FIGURE V-4  
SEWER AUTHORITY MID-COAST, CALIF.

WASTEWATER TREATMENT PLANT

WORK ORDER

DATE ORDERED: \_\_\_\_\_ WORK COMPLETED: \_\_\_\_\_

EQUIPMENT/STRUCTURE: \_\_\_\_\_

WORK TO BE PERFORMED: \_\_\_\_\_

\_\_\_\_\_

=====

MATERIALS USED:      ITEM                                      QUANTITY                                      COST


MANHOURS REQUIRED: \_\_\_\_\_

WORK PERFORMED BY: \_\_\_\_\_

REMARKS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

=====

It has been estimated that in most plant maintenance programs, this type of repair accounts for thirty percent (30%) of the time of the maintenance staff, and eighty percent (80%) of the maintenance budget. As can be seen, this type of repair needs close attention to control costs.

The work order forms the basis of the control network for reassigning and subsequently assuring breakdown maintenance costs.

4. The "Work Order Form"

The Sewer Authority Mid-Coastside (SAM) facility will make use of the Work Order Form for maintenance work to be performed. The first Work Order Form is the weekly scheduled preventative maintenance tasks to be performed. This form is produced as a computer print-out. To obtain the form follow the following procedure:

1. Turn on printer, then computer.
2. Insert P Maint I (P Maint II Card (label should be toward screen)).
3. Answer screen promptly with 2 type.
4. Type SETMISC (enter).
5. Answer prompt with 0 (enter).
6. Answer prompt with 1 (enter), 2 (enter), 2 (enter), 2 (enter), 0 (enter).
7. Answer prompt with 1 (enter), 2 (enter), 0 (enter).
8. Answer prompt with 0 (enter).
9. Type "INSTALL" (enter).
10. Answer prompt with YES.

11. Type "J".
12. Type (enter), (enter).
13. Type A.
14. Type Y in answer to prompt.
15. Type DBASE.
16. Type today's date as formulated on the screen.
17. Type USE PMAINT I (for weeks 1 thru 26), or PMAINT II (for weeks 27 thru 52).
18. Type REPORT FORM PREMAINT for (WSS= "A" or LOXX= "(X) to print where XX equals week of year desired to be printed.
19. Set paper so printing head matches to beginning of page and press (ENTER).
20. When form has finished printing, type QUIT.
21. When red light goes off on disc drive remove disc and return to holder.
22. Turn off computer and then printer.
23. Remove printed form from printer.

Figure V-5 is a typical printout of the Preventative Maintenance schedule for one week.

The routine and breakdown "Work Order Form" (Figure V-4), is to be used in the following manner. The form is a three part form. The person who notices that repair work is to be needed on a piece of equipment fills out the form and returns the last copy. The original and yellow copy is then placed in the Superintendent's "in basket". The Superintendent then reviews the Work Order and assigns a priority rating, (a priority rating system is given in Figure V-6).

The original of the Work Order is then passed on to the lead mechanic for assignment. The yellow copy is retained by the Superintendent. When the work is completed, The Work Order is also completed and returned to the Superintendent who then has any data entered onto the repair record card for the equipment. The Superintendent's yellow copy is then marked completed and returned to the originator of the Work Order.

The Work Order Form for the Sewer Authority Mid-Coastside (SAM) facility contains information regarding the piece of equipment, what may be wrong, the name of the originator, the name of the person doing the repairs, the date initiated, the date the work was completed, what type of work completed, spare parts used, and time required to complete the work.

#### 5. Purchase Requisition

Purchase Requisitions are used to advise and request management of the need for materials, supplies, or parts. The lead maintenance mechanic should always endeavor to fill out a Purchase Order well in advance of the actual need; so that parts and supplies will be on hand when required.

The standard procedure for handling the Purchase Requisition for maintenance supplies is as follows: The lead mechanic completely fills out the Purchase Requisition, after having obtained prices from more than one supplier if possible, and submits the Purchase Requisition to the Superintendent. The lead mechanic retains the copy for his own records. The Superintendent then reviews the Purchase Requisition and approves it, if it is within the budget and is reasonable.

After approval, the Purchase Requisition is then submitted to the Administrative Assistant for a Purchase Order to be issued.

A Purchase Requisition is shown in Figure V-7.

6. Organization of Maintenance Staff

The recommended staff for the maintenance division includes three and three quarter persons. Since the equipment is mostly new, the full maintenance staff was not hired the first year of operation. However, as the equipment ages the full staff will be necessary to properly maintain the plant equipment. The peak maintenance demand is usually reached about the third year of operation.

The ultimate organization would be an arrangement between mechanics, plant operators and laborers (or OIT), to accomplish the total maintenance program. Under this scheme, the mechanics would handle the routine and breakdown maintenance along with remodeling work. The operator would be responsible for the preventative maintenance. One of the laborers would be responsible to assist the mechanics when needed and would do yard and building maintenance.

One of the mechanics is the lead mechanic and is responsible for assigning Work Orders, and for completing Work Orders and Purchase Requisitions. The lead mechanic works directly under the supervision of the plant Superintendent. It is anticipated that some cooperation between the maintenance division and the operations division will have to occur, if the best use of time and manpower is to be practiced.



## 7. Inventory Control System

The plant inventory has been divided into equipment, structures, furniture, vehicles, and space parts.

The equipment and structures inventories are considered to be the capital inventory. The total amounts of each of the furniture, vehicle, and spare parts inventories are also carried to the capital account. Each of these inventories has been placed on the computer for ease of access and use.

As far as the Maintenance Management System is concerned, we will discuss only the spare parts inventory in this section.

The data base for the spare parts inventory has been setup in the computer to allow for input of purchases and usages; so that at anytime a printout can be attained showing the status of the inventory. The most recent time of purchase and the unit price last paid is also shown on the inventory list.

The system operates as follows:

The spare parts were inventoried when Sewer Authority Mid-Coastside (SAM) assumed operation of the facility. Since that time additional spare parts have been received by either purchase by SAM or by acquisition through the facility construction contract. All of the information has been entered into the data base. Future purchases will also be entered into the data base as well as parts usage as listed on the Work Orders. A monthly report of the inventory will be generated.

Those items that have remaining stock less than a present minimum amount are flagged in the report. The flagged items are then placed on Purchase Requisitions for immediate replacement.

Spare parts are stored on shelves provided for that purpose in the maintenance and spare parts storage building. No parts should ever be removed from the shelves unless the part is entered on a Work Order Form. If control of the spare parts is to be maintained, it is absolutely essential that these procedures be followed at all times.

The stocking of spare parts is governed by the following factors:

- Availability of part.
- Backup equipment availability.
- Anticipated frequency of breakdown.
- Ability to store part, without damage occurring to the part.
- Essentialism of equipment to process.

Before a spare part is placed on the shelves, an evaluation of the advisability of stocking the part should be made. It is not enough to simply say we need the part. Care should be exercised not to store parts that will become damaged or useless due to corrosion or deterioration while it lays on the shelf. The storage area is heated to prevent moisture from accumulating. The above five considerations should be looked at very closely.

## D. Specific Maintenance Instructions

### 1. MANUFACTURER'S INSTRUCTIONS

The manufacturer of each piece of mechanical equipment has provided a complete set of installation, operation and maintenance instructions.

The manufacturer's instruction manuals have been assembled in separate binders. These binders are kept at the Treatment Plant for the operator's use. The instructions they contain must be referred to for detailed information on maintenance.

### 2. MAINTENANCE OF STRUCTURES AND BUILDINGS

#### Painting

Painting of plant components at reasonable time intervals will make cleaning an easier chore, and will help to prevent rust and deterioration of tankage and equipment. Use of proper surface preparation techniques and application of proper coatings will provide long term advantages even though the initial cost and time required may be great. If surfaces are recoated at proper intervals it may be that only the top coat will have to be applied rather than complete replacement of base coats. Paint manufacturers provide excellent guidelines on the use of their products for various services.

Figure V-3B

PREVENTATIVE MAINTENANCE TASKS  
DATA BASE

PREVENTATIVE MAINTENANCE  
DATE

EQUIP NO	TASK	LUBRICATION
-------------	------	-------------

0103	COMMINUTOR 1	
010301	CHECK CUTTERS, SEALS	
0104	COMMINUTOR 2	
010401	CHECK CUTTERS, SEALS	
0113	GRIT WASHER	
011302	LUB HANGER BEARINGS	#2 EP
011303	LUB COUPLERS	#2 EP
011304	CHECK LINER	
0114	GRIT HOPPER	
011401	LUB BEARINGS	#2 EP
0115	ROCK BASKET	
011501	CLEAN BASKET	
0118	GRIT PUMP 1	
011801	CHECK BELTS	
011802	CHANGE OIL	#2 EP
011803	CHECK ROTATING PARTS	
0119	GRIT PUMP 2	
011901	CHECK BELTS	
011902	CHANGE OIL	#2 EP
011903	CHECK ROTATING PARTS	
0201	PRIMARY CLARIFIER 1	
020107	CHECK LIMIT SWITCH	
020108	LUB DRIVE CHAIN	LUBRIPLATE
0202	PRIMARY CLARIFIER 2	
020207	CHECK LIMIT SWITCH	
020208	LUB DRIVE CHAIN	LUBRIPLATE
0203	SCUM TANK	
020301	CLEAN AND FLUSH	
0204	WATER SPRAY SYSTEM	
020401	CLEAN SPRAY HEADS	
0205	PNEUMATIC EJECTOR	
020501	BLOW DOWN	
0206	PRIMARY SLUDGE PUMP 1	
020601	CHECK OIL LEVEL	
0207	PRIMARY SLUDGE PUMP 2	
020701	CHECK OIL LEVEL	
0208	PRIMARY SLUDGE PUMP 3	
020801	CHECK OIL LEVEL	
0210	SUMP PUMP 1	
021001	CHECK FLOAT CONTROL	
021002	LUB ROD WASHER	SAE 30
0211	SUMP PUMP 2	
021101	CHECK FLOAT CONTROL	
021102	LUB ROD WASHER	SAE 30
0306	SECONDARY CLARIFIER 1	
030601	CHECK LIMIT SWITCHES	
030602	LUB PILLON BLOCKS	#2 EP

PREVENTATIVE MAINTENANCE  
DATE

EQUIP NO	TASK	LUBRICATION
-------------	------	-------------

120201	CHECK AND TIGHTEN NUTS, BOLTS	
120202	CHECK FOR AIR LEAKS	
120203	CHECK BELT TENSION	
120205	CHECK OIL LEVEL	COMP OIL
120206	DRAIN WATER FROM AIR RECEIVER	
1203	HOT WATER BOILER	
120301	FLUSH WATER LEVEL CONTROLS	
120301	CHECK SAFETY VALVES	
1204	CHLORINATOR 1	
120401	CHECK FOR LEAKS	
1205	CHLORINATOR 2	
120501	CHECK FOR LEAKS	
1206	CHLORINATOR 3	
1217	ENGINE GENERATOR	
121701	EXERCISE WITH LOAD	
121702	WEEKLY MAINTENANCE	
121711	CHECK BATTERY CHARGER	
121714	CHECK COOLING SYSTEM FAN	
1218	ODOR CONTROL SYSTEM	
121801	CHECK FAN	
1220	AIR FILTERS	
122001	CHECK, REPLACE IF NEEDED	
1301	AIR COMPRESSOR	
130101	CHECK AND TIGHTEN NUTS, BOLTS	
130102	CHECK FOR AIR LEAKS	
130103	CHECK BELT TENSION	
130105	CHECK OIL LEVEL	COMP OIL
1305	ENGINE GENERATOR	
130501	EXERCISE WITH LOAD	
130502	WEEKLY MAINTENANCE	
130511	CHECK BATTERY CHARGER	
1311	COMMINUTOR	
131201	CHECK OIL LEVEL	SAE 20W
131202	LUB GEAR REDUCER	
131203	CHECK CUTTERS, SCREENS	
1401	AIR COMPRESSOR	
140101	CHECK AND TIGHTEN NUTS, BOLTS	
140102	CHECK FOR AIR LEAKS	
140103	CHECK BELT TENSION	
140105	CHECK OIL LEVEL	COMP OIL
140106	DRAIN WATER FROM AIR RECEIVER	
1406	ENGINE GENERATOR	
140601	EXERCISE WITH LOAD	
140601	WEEKLY MAINTENANCE	
140611	CHECK BATTERY CHARGER	
1407	AIR FILTERS	
140701	CHECK AND REPLACE IF NEEDED	

PREVENTATIVE MAINTENANCE  
DATE

EQUIP  
NO

TASK

LUBRICATION

1416	COMMINUTOR 1	
141601	CHECK OIL LEVEL	
141602	LUB EXTENSION ASSEMBLY	SAE 20 ND
141603	LUB GEAR REDUCER	SAE 20 ND
141604	LUB GUIDE BEARINGS	
141606	CHECK CUTTERS, SCREEN	#2 EP
1417	COMMINUTOR 2	
141701	CHECK OIL LEVEL	
141703	LUB GEAR REDUCER	SAE 20 ND
141706	CHECK CUTTERS, SCREEN	

LIST OF

EQUIPMENT MANUFACTURERS



<u>I T E M</u>	<u>MANUFACTURER</u>	<u>SUPPLIER</u>
Air Compressors	Kellog-American Model 462 TV	King Knight 602 Christie Avenue Emeryville, CA 94608
Boilers	Rite Engineering & Manufacturing, POB 310-9441 Washburn Rd. Downey, CA Thrush Pumps	Heat Transfer Equipment Co. 20 Linden Avenue South San Francisco, CA 9408
CHLORINATION EQUIPMENT	Wallace & Tiernan Div. Pennwalt Corp. 25 Main Street Belleville, NJ 07109	Borges & Mahoney, Inc. 372 Vwl Marin Keys Blvd. Suite "K" Novato, CA 94947 415
Chlorinator	Wallace & Teirman Lafatte, CA 94559	
Chloroscale	Force Flow Equipment 3467 Goldengate Way	
Chlorene Repair Kit	Clorine Specialties 123 Holloway S.F. 94112	
Chlorine Detector	Wallace & Tiernan	
Circulating Pump: Boiler Valves	Thrush Products, Inc. P.O. B0x 228	Heat Transfer 20 Linden Avenue South San Francisco, CA 9408
Communitors	Worthington Pump Co. Harrison, N.J. 07029	J.H. Pillow, P.O.B 1209 Pleasanto, CA 94566 415 462-2210
Chain Hoists	American Chain & Cable Hoist & Crane Div. 1110 E. Princess St. York, PA 17403	Walter Wyman 1832 Second Street Berkeley, CA 94710 415- 845-3990
Eccentric Valves	DeZurik Sartell, MN 56377	Leighton Stone Corp. 790 Tennessee St. San Francisco, CA 94107
Fuel Oil Pumps	Viking Pump Division Houdaille Industries Cedar Falls, Iowa 50613	Power Machine Co. 5768 Shellmound St. Emeryville, CA 415 658-9661
Float Valves	Aqua-Matic Inc 2412 Grant Ave. Rockford, IL 61101	Robert A. D/Elia, Inc. 1290 Howard Avenue Burlingame. CA 94010 415 348-8888

I T E MMANUFACTURERSUPPLIER

Fuel Oil Tanks & Guages		Petroleum Equip. Distributo 23352 Clawiter Road Hayward, CA 94545
Gauges	Pen Berthy	Frost Engineering Service 7980 Capwell Drive Oakland, CA 94621 415 568-7000
Gauges	Ashcroft/Dresser Industrial Valve & Instrument Div. Straford, CN	Leighton Stone Corp. 790 Tennessee San Francisco, CA 415 285-3600
Generators	Engines: Cummins NT-855-G White Hercules D-4800TA Generators: Lima W/C 1047 Frame 580 Lima W/c 812 Frame 440	Zia Kahn Associates 330 N. Edison Street P.O.B. 8520 Stockton, CA 95208
Hydropneumatic Tanks/Air Gap Tanks		Phillips & Associates 3871 Piedmont Ave. Oakland, CA 94611 415 653-9752
Odor Control Equipment	Western Technology Associates Anaheim, CA 92806	Shamrock Engineering Co. 845 Malcolm Road Burlingame, CA 94010 415 679-3326
Pressure Switches	Jensen Instrument Co 345 Littlefield Ave. So. S. F. CA 94080	Jensen Instrument Co. 345 Littlefield Ave. S. S. F. CA 94080
Pressure Switches	Jensen Instrument Co 345 Littlefield Ave. So. S. F. CA 94080	345 Littlefield Ave. 345 Littlefield Ave. So. S. F. CA 94080
Refrigerated Air Dryer	Deltech Engineering, Inc Century Park Newcastle, DE 19720	Power Machine Co. 5768 Shellmound Street Emeryville, CA 94608
Roll-Up Doors	Cookson Co.	Cookson Co. 700 Pennsylvania Ave. San Francisco, CA.
Sewage Pumps And Motors	Pump Manufacturer: Clow Corp-Pump Div. 1999 N. Ruby St. Melrose Park, IL 60160 Motors Manufacturer: U.S. Motors Div of Emerson Electric Co. 125 Old Gate Lane Milford, CN 06460	Envirotrol 101 Casa Buena CorteMadera, CA 94625

I T E MMANUFACTURERSUPPLIER

Sluce Gates

Waterman Industries

Waterman Industries  
P.O. Box 458  
Exeter, CA 93221  
209 592-3174

Sump Pumps

Pacific Pumping Co

Pacific Pumping Co  
P.O.B. 12924  
Oakland, CA 94604  
415 562-5628

Water Pumps

Paco Pumps

Pacific Pumping Co  
P.O.B. 12924  
Oakland, CA 94604  
415 562-5628

- B I B L I O G R A P H Y -

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